Radiation Belt Storm Probes (RBSP) and Geospace-Related Missions of Opportunity (GMO) Preproposal Conference

Technical, Management, and Cost (TMC) Evaluation

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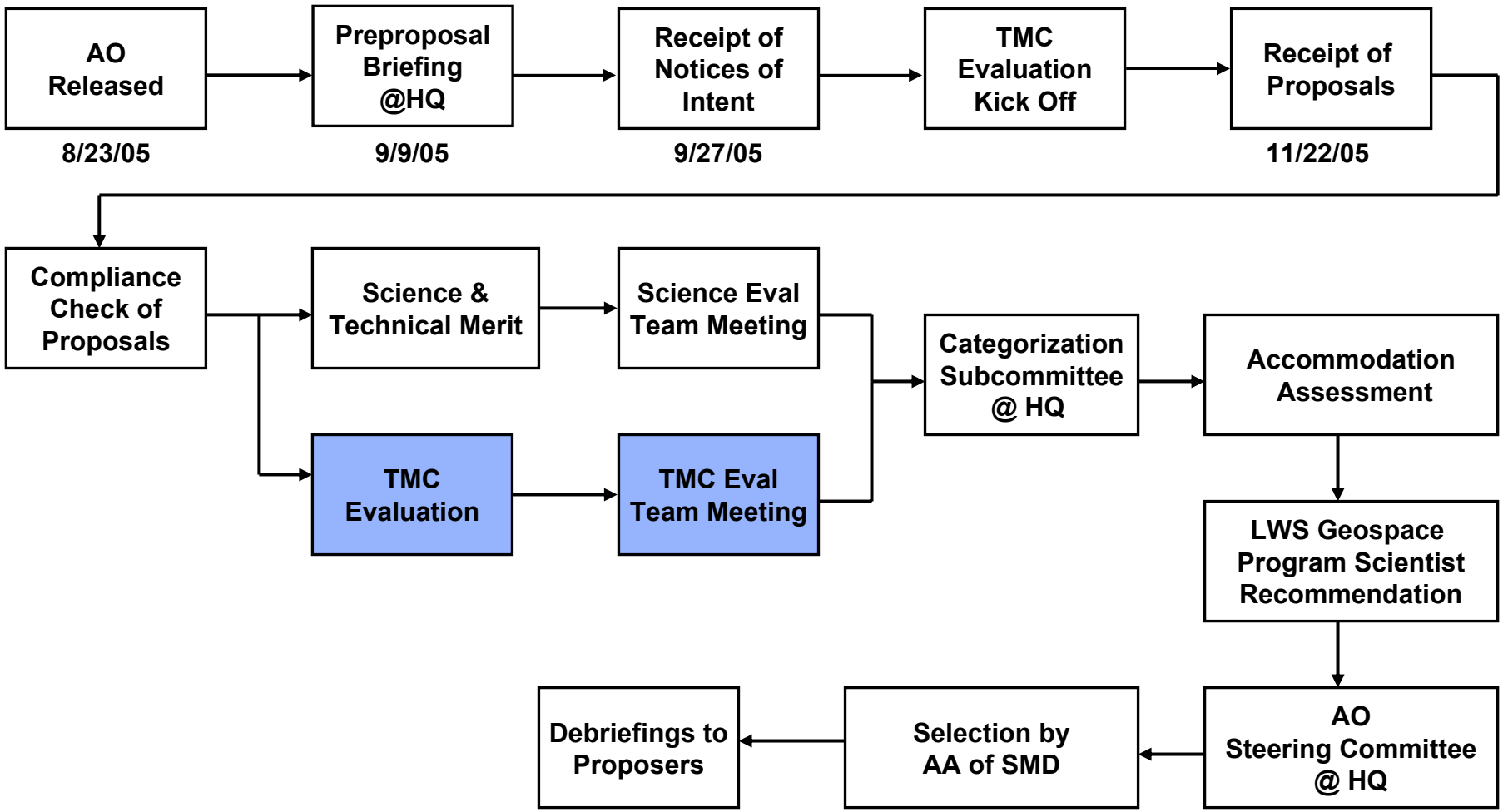
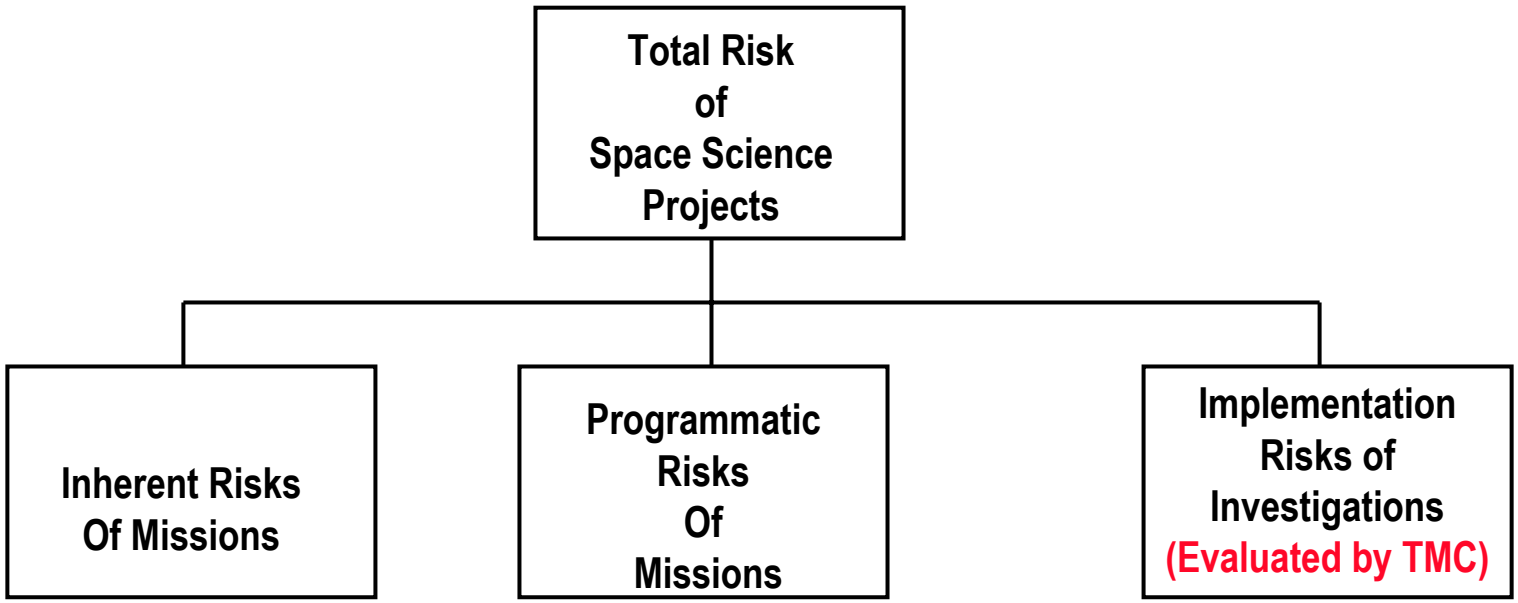
RBSP & GMO Proposal Evaluation Process



Space Science Mission Risk



Risks that are unavoidable to do the investigation:

- Launch environments
- Space environments
- Mission durations
- Technologies or technology extensions
- Unknowns
- Etc.

Risks that are uncertainties due to matters beyond project control:

- Environmental Assessment approvals
- Budgetary uncertainties
- Political impacts
- Late/non-delivery of NASA provided project elements
- Etc.

Risks that are associated with implementing the investigation:

- Adequacy of planning
- Adequacy of management
- Adequacy of development approach
- Adequacy of schedule
- Adequacy of funding
- Adequacy of Risk Management (planning for known & unknown)

RBSP and GMO Defined from a TMC Perspective

- Selection (Phase One) Proposal Risk Assessment:
  - The Phase One Selection is based primarily on Science.
  - The TMC Risk Assessment is based on a *preliminary concept* with appropriate benefit of the doubt given to the Proposer.
  - The TMC Cost Analysis results in a cost risk rating that is integrated into the TMC Risk rating.
- Geospace-Related Missions of Opportunity (GMO) investigations will be evaluated using same criteria as investigations.
- Quality of Plans for Education & Public Outreach, and Small Disadvantaged Business Subcontracting are NOT Evaluated in the Selection Phase.
  - A preliminary subcontracting plan is required. Section 5.12.2, Appendix A Section XIII, Appendix B Section G
  - Every proposal to this AO must contain an E/PO statement of commitment. Appendix B Section G
    - Proposers are welcome to provide a brief discussion of any unique characteristics of the instrument that might provide unusual opportunities for E/PO.

TMC Principles

- Basic Assumption: Proposer is the expert on his/her proposal.
  - TMC: Task is to try to validate proposer's assertion of Low Risk.
  - Proposer: Task is to provide evidence that the project is Low Risk.

- All Proposals will be reviewed to identical standards.
  - The TMC process is used by SSO to support all SMD evaluations with a standard process.
  - Evaluation Plan approved by NASA Headquarters and in place before proposals arrive.
  - All proposals receive same evaluation treatment in all areas and by all reviewers.

- All evaluators will be experts in the area of expertise that they evaluate.

- TMC Findings will be the consensus of the entire TMC panel.
  - Findings that are above expectations are documented as strengths. Findings that are below expectations are documented as weaknesses. Findings that are as expected are not documented.

Definitions for the TMC Evaluation

•Major Strength: A facet of the response that is judged to be well above expectations and can substantially contribute to the ability to meet technical commitments on schedule and within cost.

•Major Weakness: A deficiency or set of deficiencies taken together that are judged to substantially affect the ability to meet the proposed technical objectives within the proposed cost and schedule.

•Minor Strength: A strength that is substantial enough to be worthy of note and brought to the attention of Proposers in debriefings but is not a discriminator in assessment of risk.

•Minor Weakness: A weakness that is substantial enough to be worthy of note and brought to the attention of Proposers in debriefings but is not a discriminator in assessment of risk.

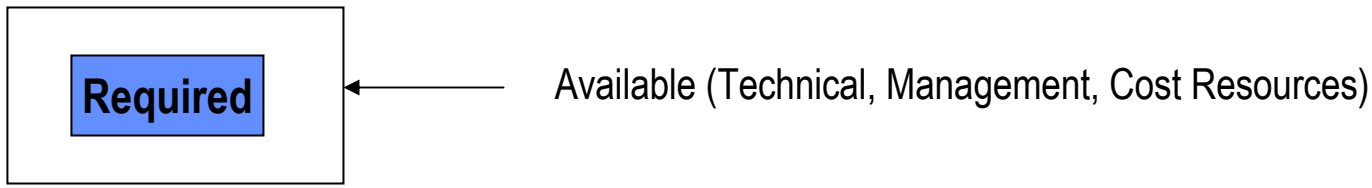
TMC Risk Ratings

- The TMC evaluation is to determine the level of risk of accomplishing the scientific objectives of the investigation, as proposed, on time and within cost.
  - For an individual instrument proposals there will be one TMC grade.
  - For a suite proposal there will be one TMC grade for the suite and one for each instrument.
  - The TMC evaluation results in a narrative text, as well as a TMC grade.
- There are three possible TMC grades: Low Risk, Medium Risk, and High Risk.
  - **Low Risk**: There are no problems in the proposal that cannot be normally solved within the time and cost proposed. Problems are not of sufficient magnitude to doubt the Proposer's capability to accomplish the investigation. "Envelope more than adequate"
  - **Medium Risk**: Problems have been identified, but are considered within the proposal team's capabilities to correct with good management and application of effective engineering resources. Technology may not be ready, but available time and money should get it there. Investigation may be complex and resources tight. "Envelope adequate but tight"
  - **High Risk**: Problems are of sufficient magnitude such that failure is highly probable. "Envelope inadequate"

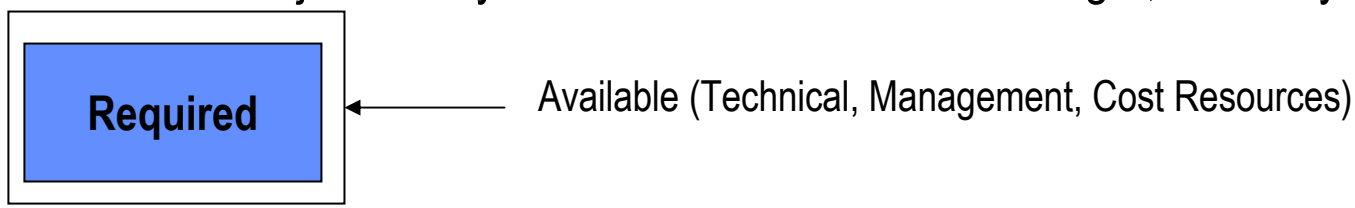
TMC Envelope Concept

Envelope: All TMC Resources available to handle known and unknown development problems that occur. Includes schedule and funding reserves; reserves and margins on physical resources such as mass, power, and data; descope options; fallback plans; and personnel.

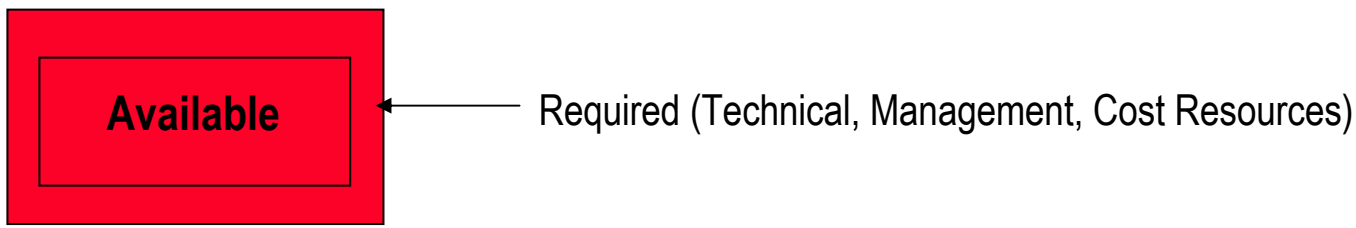
Low Risk: Required resources fit well within available resources



Medium Risk: Required resources just barely inside available resources. Tight, but likely doable



High Risk: Required resources DO NOT fit inside available resources. Expect project to fail



Technical, Management, and Cost (TMC) Criteria - AO Section 7.2.4

- The soundness of the technical and management implementation approach, schedule, and cost realism and reasonableness will be the primary factors considered in determining the Technical, Management, and Cost (TMC) Risk.
- Each investigation will be evaluated to assess the likelihood that it can be implemented as proposed, including an assessment of the risk of completion within the proposed costs.
- The evaluation will consider implementation factors such as the technical approach to design, develop, integrate, and test the proposed instrumentation hardware and software to meet the investigation requirements within the mission's constraints defined in the AO; the adequacy and robustness of the proposed resources (technical, management, and cost); the management approach and the adequacy of the proposed organizational structure; the competence and relevant experience and past performance of the proposed technical and management team; the relevant experience and past performance of the proposing organizations; the soundness of plans and commitments of partners and contributors; the team's understanding of the scope of work (covering all elements of the investigation, including contributions).
- The relationship of the work to the project schedule, the project element interdependencies, and associated schedule margins will also be evaluated to ensure that the investigation can be successfully completed and delivered within budget and meet the project schedule milestones.

Technical, Management, and Cost (TMC) Criteria - AO Section 7.2.4

- The investigations use of new technology will be assessed. Investigations proposing new technology, i.e., technologies having a Technology Readiness Level (TRL) less than 6 will be assessed a higher risk rating if adequate backup plans to ensure success of the investigation are not described.
- The proposal must discuss the methods and rationale (cost models, cost estimating relationships of analogous investigations, etc.) used to develop the estimated cost, and must include a discussion of cost risks. The proposal must also demonstrate the capability and plan to adhere to sound business practices. Cost realism and cost reasonableness will be used to determine an overall cost risk (uncertainty) associated with the investigation.
- The commitment of every partner, U.S. or non-U.S., offering a contribution must be documented in letters of endorsement. For proposals offering contributions that are critical to the success of the proposed investigation, the evaluated risk will increase if the proposals: 1) do not have clear and simple technical and management interfaces in the proposed cooperative arrangements, 2) do not provide evidence in the proposal that the contribution is within the scientific and technical capability of the partner, and 3) do not have the required endorsement or a firm commitment to provide the offered contribution. Adequate contingency plans for coping with the failure of a proposed cooperative arrangement may help to reduce the evaluated risk.

RBSP and GMO AO Highlights

- RBSP Investigations
  - Individual instruments or suites of instruments may be proposed. Section 1.4
  - Proposals for multiple instruments (suites) must provide science, technical, and cost information for each instrument sufficient to allow for separate evaluation and selection. Section 1.3
  - More proposal pages are allowed for each additional instrument. See Table B.1
  - The proposer may identify variations of proposed instruments or suites of instruments that reduce the impact of the instrument/suite on spacecraft resources and saves cost. The reduction in spacecraft resources (mass, power, telemetry) and cost should be clearly defined and the impact of the instrument or suite change on the science capability of the instrument must be described and related to the science objectives in section 2 of the AO. Appendix B Section D 5.a
  - More cost tables are required for RBSP multi-instrument proposals. Appendix B Section F
    - One Table B.4, B.5 and B.7 for suite.
    - A separate table B.4 is required for each individual instrument reflecting the cost as if it were selected separately. An explanation should be provided with each Table B.4, for an individual instrument in a suite, noting whether there are any performance changes or design changes if only the single instrument is selected.
    - If a variation of an instrument has been discussed in order to save spacecraft resources or cost, a separate Table B.4 should be submitted.

RBSP and GMO AO Highlights

- Geospace-Related Missions of Opportunity
  - One grade for each Mission of Opportunity proposal regardless of the number of instruments.
  - One Table B.5 and B.6 and B.7
  - Mission of Opportunity Guidelines also apply to the Low Cost Access to Space proposals discussed in Amendment 1 to the AO.
  - NASA will evaluate only the proposed GMO investigation and not the sponsor's entire mission. Section 5.10.2 and 7.2.1
  - Same evaluation criteria in section 7.2
  - Sufficient information about the candidate Mission of Opportunity and the host mission must be provided to enable NASA to assess the performance, schedule, and cost risk associated with the mission. Section 5.10.2
  - It is incumbent on the proposing investigator to provide evidence in their proposal that the sponsoring organization intends to fund the mission and state when the endorsement of NASA for U.S. participation is required. Section 5.10.3

RBSP and GMO AO Highlights

- Cost Section 1.4
  - Proposers must estimate the Total NASA Cost (all costs necessary to complete the investigation beginning with Phase A through Phase E, including reserves) in their proposals.
  - Investigators should cost their Phase E efforts to provide for the entire analysis effort for their investigations during the first three years after launch (two years of spacecraft operation plus one year of additional data analysis).

RBSP and GMO AO Highlights

- Minimum Science Investigation and Descopes Section 5.7
  - Every investigation must specify a "Proposed" investigation and a "Minimum Science" investigation.
  - The Minimum Science Investigation must be identified and documented for a proposed investigation along with a plan for the prioritized descoping of capability from the Proposed Investigation to the Minimum Science Investigation in the event of cost or schedule growth, for risk mitigation, or for partial selection. Proposals must define descope options in their proposals, decision dates for implementation, costs avoided, and science impact associated with each descope option.
- Proposals will be evaluated in the context of the maximum payload resources in Table 5.2. Section 5.2.2
  - Proposals must separately and clearly identify (1) estimated allocation for each instrument resource, including the basis of the estimate, and (2) adequate reserves for each resource along with a rationale based on requirements uncertainty, design maturity, flight heritage, and risk.
  - Investigators are responsible for the design, qualification, and delivery of any deployed structures or components required by their instruments, including, but not limited to, elements such as radiation shielding, support booms, armatures, intra-instrument harnessing, thermal blankets, covers, or operational heaters.

RBSP and GMO AO Highlights

- Reserve Policy Section 1.4
  - Proposers shall outline their reserves plan indicating the appropriate amounts of technical, schedule, and cost reserves based on design maturity and flight heritage. All investigations must include adequate reserves at every phase of the mission lifecycle.
  - In particular, investigations must plan to maintain a reserve through the end of Phase B of at least 25 percent of all costs though the end of Phase D. A cost reserve for Phase E must also be included as appropriate.
  - Proposers should not assume that the RBSP Project Office will maintain any reserves beyond those proposed.
  - In general, schedule reserve must be approximately four weeks per year for Phases C and D.

RBSP and GMO AO Highlights

- Technology
  - Areas requiring critical technology development of the instrument for flight readiness shall be identified. Should a new technology that represents an untested advance in the state of the art be proposed for use, an assessment will be made of the likelihood of its scientific success. Section 7.2.3
  - The investigations use of new technology will be assessed. Investigations proposing new technology, i.e., technologies having a Technology Readiness Level (TRL) less than 6 will be assessed a higher risk rating if adequate backup plans to ensure success of the investigation are not described. Section 7.2.4

RBSP and GMO AO Highlights

- Proposals may reflect changes to the concept payload, concept spacecraft interfaces, or other spacecraft characteristics as necessary in order to achieve their proposed science goals. However, any changes to the nominal payload resources or concept spacecraft characteristics needed by a proposed payload must be clearly indicated and justified in the proposal. Section 5.2.2
- Relevant experience and past performance (successes and failures) of the major team partners in meeting cost and schedule constraints in similar projects within the last ten years must be discussed with a particular emphasis on the incorporation of lessons learned from previous projects and any mitigating circumstances. Appendix B Section H.10
- The proposed WBS must conform to the standard WBS in Appendix J of the NPR 7120.5C NASA Program and Project Management Processes and Requirements. Section 5.6.1

TMC Evaluation Considerations for RBSP & GMO Investigation Proposals

- **Management, Organization, & Schedule**
  - Organizational Structure & Work Breakdown Schedule (WBS)
  - Past Experience
  - Roles & Responsibilities
  - Risk Management, Including Descope Plan & Decision Milestones
  - Instrument/Suite schedule with critical path

- **Instrument System (s)**
  - Hardware/Software Design
  - Design Heritage
  - Systems Engineering
  - Design Margins
  - Qualification & Verification
  - Instrument design and operation in expected radiation environment.
  - Plans for Mitigation of radiation environment

- **Investigation Integration**
  - Accommodation by planned S/C design (mechanical, thermal, structural, ACS, C&DH, etc.)
  - Impact on planned resources for payload.
  - Impact on planned mission operations.
  - Instrument unique requirements and interfaces.

- **Cost**
  - Basis of Estimate (BOE)
  - Cost Realism & Completeness
  - Cost Reserves by Phase
  - Comparison with TMC Estimates (Including Parametric Models/Analogies)

Note: **For GMO's, NASA will evaluate only the portions of the investigation that are funded by NASA including interfaces to Sponsoring Mission.**

Some TMC questions to be answered related to Management, Schedule and Organization

Evaluation Question: Is the proposed management plan and organization appropriate and adequate for the scope and complexity of the proposal?

- Organization Structure
- Organizational Experience
- Past Performance
- Organizational Commitment
- Management Process and Tools
- Management Team Roles and Responsibilities
- Risk Management Plan

Under this AO, the scope and complexity of the proposal could vary widely between a individual instrument proposal and a proposal for a suite of instruments. The development plans, schedules, organization and management plans must appropriately address the complexity of the proposal.

  - For example: A proposal for a suite of instruments with components built by geographically distributed institutions will have a more complex organizational structure than a single instrument built in one location.

Some TMC questions to be answered related to Management, Schedule and Organization

- **Organization Structure**: Is there evidence in the proposal that the proposed organization structure reflects the proposed work?
- **Organizational Experience**: Is there evidence in the proposal that the proposed roles and responsibilities are appropriate?
    - Have the proposed organization performed these roles successfully in the past? If not what corrective action is planned?
    - Have proposed partners worked successfully together in the past?
    - If the team has many partner institutions with complex interdependencies that are geographically dispersed, what is the value of each partner in relation to the risk of the additional complexity?
- **Past Performance** of each Institution: What is the relevant experience and past performance of each proposed institution at performing similar work in the past?
- **Organizational Commitment**: Is there evidence in the proposal of a firm commitment from each institution involved in the proposal?

Some TMC questions to be answered related to Management, Schedule and Organization

- **Management Processes and Tools:** Is there evidence in the proposal that the proposer will be able to successfully manage the development of the investigation?
  - What tools and process will the proposal team use during the development process to provide timely insight into the technical, schedule, and cost performance of all team members against the planned activities?
  - Does the proposal reflect adequate management processes and tools to demonstrate that the proposer will be able to plan, monitor, and control the development of the investigation?
  - Will the proposed tools and process allow timely insight by the proposer into development status of the entire investigation?
  - Will the use by the proposer of the proposed tools and processes allow early identification of problems?
  - What is the planned use of these tools? Who will use the tools? How often will data be updated?
  - Have the institutions used the tools and processes successfully in the past?
  - Are all proposal team members using the same tools and processes? If not, how will data be gathered from other institutions.

Some TMC questions to be answered related to Management, Schedule and Organization

- **Management Processes and Tools (continued):** Is there evidence in the proposal that the proposer will be able to successfully manage the development of the investigation?
  - Are the proposed management processes and tools appropriate for the scope and complexity of the proposal? For more complex proposals, proposers need to provide more evidence that adequate management tools and process are in place to allow the proposer to successfully manage a complex development effort.
  - How will the proposal team communicate and monitor the technical, schedule and cost interdependencies?
  - How will the proposer report progress? How often? Will the information reflect recent investigation status? Does all the reported status reflect status as of the same date.
  - How will the proposed management identify problems and take corrective action?
  - How will cost, schedule, and technical reserves be managed over the development cycle?
  - Is the proposed systems engineering process adequate?

Some TMC questions to be answered related to Management, Schedule and Organization

- **Management Team Roles and Responsibilities:** Is there evidence in the proposal that the management team have appropriate roles and have adequate insight to successfully manage the development effort?
  - Are the roles and responsibilities or the management team appropriate?
  - Has the PI and other key personnel performed similar work in the past successfully?
  - Does the PI have clear management authority over the entire proposed investigation?
  - Are the division of responsibilities among the PI, PM and System Engineer appropriate?
  - Are the responsibilities of other key personnel appropriate?
  - Does the PI and PM have adequate insight and control over the entire proposed investigation?
  - What are the decision making processes and limits for the key personnel?

Some TMC questions to be answered related to Management, Schedule and Organization

- **Risk Management Plan**: Is the risk management plan adequate to identify problems with sufficient warning to allow for mitigation without impacting the investigation objectives?
  - What is the risk management approach?
    - How will risks be identified, mitigated and tracked?
  - Will the proposed risk management process ensure successful achievement of the objectives within established resource, funding, and schedule constraints?
  - Are there any new technologies? What is the TRL level of all critical components of the investigation?
  - What is the risk mitigation approach for new technology?
  - Is the proposal compliant with the Geospace Mission Assurance Requirements (MAR) document?
  - What are the top risks? How does the proposer plan to manage those risks?
  - What is the descope plan from the Proposed investigation to the Minimum science investigation?
  - Is the science impact identified for each descope. Are decision points defined and cost savings identified for each descope?

Some TMC questions to be answered related to Management, Schedule and Organization

Evaluation Question: Is the proposed schedule adequate for the scope and complexity of the proposal and allow sufficient contingency to indicate there is a reasonable probability of delivering on time?

- Does the schedule reveal an understanding of the work to be done and the time it takes to do it?
- Is there adequate funded schedule margin?
- Does the proposers schedule support the project schedule in Table 5.4?
- Are major milestones shown on the schedule?
- Is the critical path clearly identified?

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Note: **For GMO's, NASA will evaluate only the portions of the investigation that are funded by NASA including interfaces to Sponsoring Mission.**

Some TMC questions to be answered related to Instrument Systems, Integration, and Cost

- Will overall instrument/suite design allow successful implementation of investigation as proposed?
- Are there sufficient resources (time & $) to correct problems?
- Does proposed design/development allow the investigation to have a reasonable probability of accomplishing its objectives and include all needed tools? Does it depend on new technology that has not yet been demonstrated? Are requirements within existing capabilities or are advances required? Does the Proposal accommodate sufficient resiliency in appropriate resources (e.g., money, mass, power) to accommodate development uncertainties?
- Does the investigation, as proposed, have a reasonable chance of being accomplished within proposed cost? Are proposed costs within appropriate caps and does the proposers cost estimate cover all costs including full-cost accounting for NASA Centers? Are costs phased reasonably? Is there evidence in the Proposal to give confidence in the proposed cost? Does the Proposer recognize all potential risks/threats for additional costs or cost growth?

Cost Evaluation Process

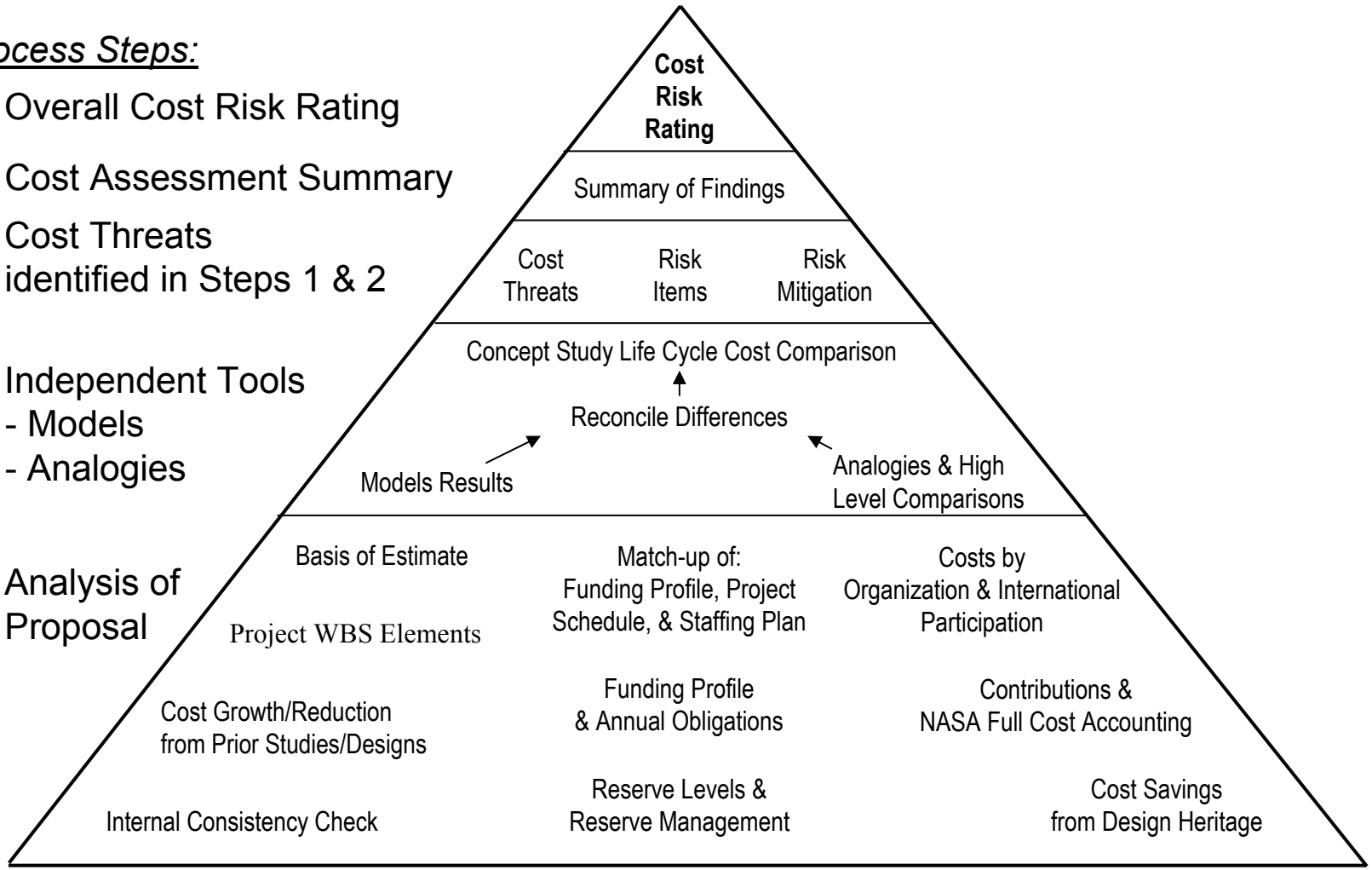
- An initial cost analysis is accomplished based on information in the Proposals (consistency, completeness, proposed basis of estimate, contributions, use full cost accounting, maintenance of reserve levels, and cost management, etc.).
- Several independent cost models will be used to analyze proposed cost.
- The cost threats, risks, and risk mitigation analysis will be analyzed.
- All information from the entire Evaluation Process provides a final assessment.
- Cost Realism is only reported as a Cost Risk (Low, Medium-Low, Medium, Medium-High, High); based on Models, Analogies, Heritage, and Grass Roots information from Proposals.

TMC Independent Cost Assessment Pyramid

"The Pyramid"

Process Steps:

5. Overall Cost Risk Rating
4. Cost Assessment Summary
3. Cost Threats identified in Steps 1 & 2
2. Independent Tools
   - Models
   - Analogies
1. Analysis of Proposal



Some Characteristics Applicable to a Low Risk Rating

- All risks for the project have been/are being identified and managed by the team, with plans to reduce or retire the risk before delivery.
- No risk exists for which there is neither a workaround planned, nor a very sound plan to develop and qualify the risk item for flight.
- The proposed project team and each of its critical participants are competent, qualified, and committed to execute the project.
- The investigation will be managed by the proposer to a successful conclusion while providing reasonable visibility for oversight.
- The team has thoroughly analyzed all project requirements, and the resulting resources proposed are adequate to cover the projected needs, including an additional percentage for growth during the design and development, and then a margin on top of that for unforeseen difficulties.
- Reserve time exists in the schedule to find and fix problems if things do not go according to plan.
- Any contributed assets for the project are backed by letters of commitment.
- The team understands the seriousness of failing to meet technical, schedule, or cost commitments for the project in today's environment.

TMC Key Technical Definitions

•**Contingency (or Reserve):** When added to a resource, results in the maximum expected value for that resource. Percent contingency is the value of the contingency divided by the maximum expected value of the resource less the contingency.

•**Margin:** Is the difference between the maximum possible value of a resource and the maximum expected value for a resource. Percent margin for a resource is the available margin divided by its maximum expected value.

•**Example:** A suite has a maximum expected value of 40 kg, which includes 5 kg of reserve. The percent reserve is 14%. The maximum possible value of the resource is 44 kg so the percent margin is 10%.